WORK AND RECREATION IN THEIR RELATION TO HEALTH.

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I HAVE chosen for my lecture this evening a subject which affects deeply the interest and happiness of every one present—a subject which we all have to deal with, "Work and Recreation." Every one, I suppose, who comes into this world finds that he has something to do—that he has within him a power or force which must find expression, whether for good or for bad, in some outward action, or in some line of life; and every one must find, however important his work may be to himself or to other people, that that force or power is not a continuous one—that he cannot go on without an occasional break or interval, which is necessary for rest, and for what we call recreation. However we ook at life, whether from a scientific or from a moral point of view, there stands out in bold relief, above all other considerations, the simple truth that we must work, and that we must rest. So general, indeed, is this principle that there appears to exist, not only in the case of man, but, if we look at it carefully, in the whole organic world of animals and plants, a constant interchange or vibration between activity and rest.

If we begin by laying down some sort of definition stating what we mean by work and recreation, I must take it for granted that every one present has a good common-sense notion of the meaning of the terms force or energy. You all know what is meant by strength of body and strength of mind, and the relative conditions of weakness of body and weakness of mind. You are aware that one man can put forth a great deal more force and energy to accomplish a given object than another man, and that the same man can put forth more energy at one time than at another.

Let us begin then by saying that work is the putting forth of energy, and that recreation is the means by which that energy is supplied. It may be a very faulty definition, but it is sufficiently accurate to serve as a groundwork.

I wish this evening to explain as briefly as possible how in our body energy is put forth and work done, and how this energy is supplied; to show you that to work well, whether with the mind or the body, there must be kept up a constant equilibrium between the energy given out and the supply taken in—between labour and recreation; and, lastly, to point out some of the evils which result from a loss of this equilibrium; or, in other words, some of the results, on the one hand, of overwork, and, on the other, of idleness.

Let us compare for a moment the human body with a machine—such a machine as the steam engine. Every Manchester man is familiar with machinery, and most of us know how to appreciate a good machine which, with the smallest amount of outlay, will do the largest amount of work. I wish it were possible in the brief space of time I have at my disposal to give you some limited, though clear, idea of that most perfect of all mechanisms, the human body—a mechanism so delicate in construction, and so wonderful in results, that until the last 300 or 400 years men were content to regard it as an inscrutable mystery, so wonderful that it would be presumption to inquire into it too deeply.

In such a machine as the steam engine we have three important points to consider—the work to be done, the strength and arrangement of the machinery, and the supply of force. In an ordinary machine, you know, these three points can be determined and calculated with mathematical accuracy, and to a limited extent we can avail ourselves of similar calculations with regard to the human body. In the case of the human body, however, there is one important difference in force expenditure compared with that of an ordinary machine, namely, the amount of work done is not altogether under our control, and cannot easily be brought under exact observation. A very large amount is involuntary work, such as the rhythmical action of the heart and the peristaltic movement of the bowels; and again, a very large portion of the energy is put forth in the form of heat, which is very difficult, under the varying conditions of life, correctly to estimate. Still, with regard to these hidden processes, we are learning more and more every day, and our knowledge is becoming more accurate and useful. On the other hand, a large part of the force is exerted by what are called the voluntary mechanical organs of the body, such as those of movement and locomotion, over which we have, or ought to have, complete control. It is this voluntary work that we have more particularly to deal with now, though you must remember that there is no one part of the human body that is independent of the rest with regard to healthy work. Even the brain itself, which does not seem to be so directly or immediately affected by what is going on elsewhere, is, to a much greater extent than most people appear to believe, dependent for its healthy action upon the well-being of the rest of the body.

Owing to the complexity of our human body, and the varying conditions of health and strength, it is impossible to lay down any fixed rule which shall accurately determine the amount of external or voluntary work which the average healthy man should do. Various estimates have been given, based upon the amount of force which an average man can put forth in some common exertion, as, for instance, in walking. Professor Haughton, of Dublin, has shown that in walking on a level surface a force is exerted equivalent to raising 1-20th part of the weight of the body through the distance walked. If by an easy calculation we change this into the weight raised one foot, we shall find that in walking one mile, supposing a man to weigh 150lb. with his clothes, the amount of work done would equal 17·67 tons lifted one foot; and in walking 20 miles this would equal about 353½ tons lifted one foot. From many observations which have been made upon this particular kind of exercise—walking, with and without carrying a weight—it has been found that for a healthy strong adult the amount of voluntary force he can put forth in a day's work, without injury to health, equals 300 tons lifted one foot; and, according to Professor Parkes, to preserve the body in health, a man should daily take an amount of exercise in some way which shall be equal to about 150 tons lifted one foot, or a walk of about nine miles. That is, of course, if there were no other expenditure of force in business pursuits.

Now such calculations as these, though approximately true, and under certain circumstances useful, are not practically of much service in the every-day work of life—for, as I said before, there is in the human machine a large expenditure of force which takes place within the body, of a very indeterminate kind—and so, in ascertaining the amount of work to be done by an individual in any of the many employments by which daily bread is earned, we are guided more by past experience than by a scientific rule. To quote a familiar expression, "We don't know what we can do until we try." Generally speaking it is perhaps wiser to determine the amount of energy we can put forth by what we see requires doing, by what we see the average man do, than by any fanciful rule as to what we are capable of doing. There is probably far more derangement of the human body brought about by too little work than by too much. Still if we carefully examine the mode of life of those who do the most good work in any department of life we shall find that, consciously or unconsciously, they have to some considerable extent carried out those principles of healthy living which scientific investigation has proved to be correct, and which it is my purpose this evening, in a very limited manner, to explain.

So much then for the amount of work which our human machine has to accomplish. What of the machine itself? We have now principally to deal with the voluntary work, and we will take a portion of the body over which we have perhaps the most control—the upper extremity, or arm. Though not the strongest part there is no other in which we can see to such perfection, great delicacy of movement combined with great power, for in this part is exhibited the force which can put together a watch, or wield a sledge hammer. Surely a wonderful mechanism, so wide in its application, and yet so delicate in its adjustment.

As you are no doubt aware, the direct agents in producing mechanical force in our body are the muscles, which constitute what is called the red flesh of animals. These muscles consist of delicate fibres, of microscopic minuteness, which are collected together into bundles, or fasciculi, these being joined together into distinct muscles by an investment of what is called fibrous tissue. Generally these muscles are of an oblong shape, and furnished with tendons at either extremity, by which they are fixed to the bones. They vary much in size, and consequently in the amount of force which each is capable of exerting. Every fibre of which they are composed is endowed with a remarkable and characteristic property, which enables it to contract or shrink quickly under the influence of certain stimuli. In the muscles we are considering this contractility is usually called into play by the stimulus of the will acting through the nerves. We wish to make a certain movement, and immediately the command is sent through the nerves to the proper muscles, and these muscles contract or shorten, and the bones to which they are attached move. The bones are united together by joints, through which the various movements take place; and if you carefully notice, you will perceive that they are arranged, for the most part, so as to act as levers. A reference to the diagram will enable you to see this arrangement. Very generally throughout the body, and especially in the upper extremity, this application of the lever is apparently disadvantageous, from the mechanical point of view—that is, the force required is greater than the resistance or work to be overcome, the force being applied nearer to the fulcrum than the weight; but in other respects there is a great advantage in this, for by a very small contraction of the muscles we obtain much greater range, and much greater precision of movement, than by any other arrangement.

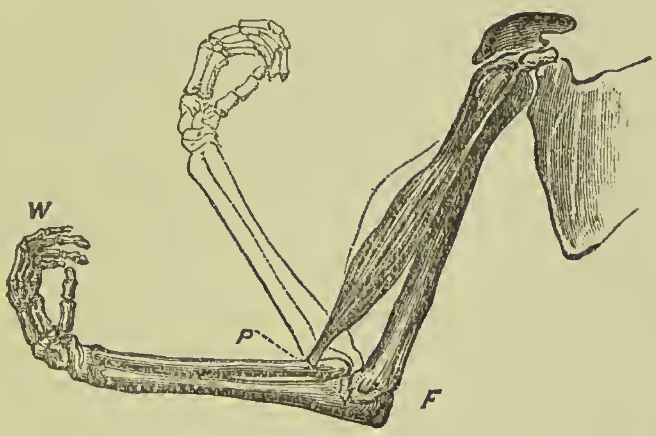

Diagram showing action of biceps muscle upon bones of forearm, the arrangement being that of a lever (of the third kind), in which P, the attachment of the muscle, is nearer to F, the fulcrum upon which the forearm moves, than W, the weight (of the hand and of anything it may hold).

I have spoken of the nerves as carrying to the muscles the stimulus to contract. Every muscle is supplied with a delicate cord of nervous tissue, connecting it with the brain or spinal axis, and along these cords is conveyed a force which irritates the muscle and causes it to contract, so that the exercise of the will upon the nerves before ever the muscles contract is a display of energy which we call nerve force. I wish you here to remark that the putting forth of nerve force is the most important, and in every way the highest, function possessed by the human body. Every thought which passes through the mind, no less than every voluntary muscular movement which takes place in our limbs, is an exhibition of nerve power; in the former case directly, and in the latter indirectly. Acting by itself this nervous tissue is the machinery by which ideas are evolved, and when it acts upon the body it produces or stimulates movement. So that we must regard our nervous system as the noblest part of the human machine, because, although we see and know least of its action, we know that it presides over and regulates all the rest. You remember how in the late Franco-German war there were thousands of men and hundreds of officers who fought hard and bravely for that cause in which the German arms were victorious, and yet Count Von Moltke, the general to whose skill the success was mainly due, perhaps never during that campaign unsheathed his sword, or took more muscular exercise than was necessary to keep his digestion in good order. But still, as an individual, his brain-work, directing the muscles of that vast army, was incomparably superior to the work of any other man under his command. Of the exact nature of this force, which seems to pass like an electric current along the nerves to the different muscles, causing them to contract, we are ignorant. Do not, however, for a moment suppose that the contracting force of a muscle or the stimulating force of a nerve originates within the body. We cannot create power. It must come to us from without. In addition to muscles and nerves, we have in our upper extremity blood-vessels, delicate channels or pipes, through which passes a constant stream of fluid which we call blood. I cannot here enter into any detailed account of the circulation of the blood. Previous lecturers have described this to you, and we have lately had the privilege in Manchester of hearing from Professor Huxley an excellent account of Harvey's great discovery. I must, however, remind you that all the tissues of the body are supplied with blood, some very richly and others very meagrely. The greater the energy put forth by any part of the body the larger, as a rule, is the amount of blood which is supplied. In fact, we are generally able to judge of the functional activity of any part by the number of blood-vessels which pass through it, or, as we say, by its vascularity. Thus to the brain and the muscles, in which there is constantly given out a large amount of force, either in the form of heat or mechanical work, there is given more than twice the quantity of blood compared with that which is supplied to an equal weight of bone.

Another most wonderful arrangement in this blood supply is that not only does the supply of blood channels to each tissue vary in direct proportion to its general activity, but also that the channels themselves are enabled to widen or contract, and thus admit more or less blood to the part, according to the amount of energy given out by that part at different times. It may be the brain, or a muscle, or the stomach, which at any moment is doing more work than usual; there is perhaps some extra strain thrown upon it; and just at that time there takes place a widening of the blood channels of the working organ, and an extra supply of blood is furnished—of course, at the expense of some other part that does not happen to be busy at the same moment.

You are all familiar with the feeling of external chilliness which sometimes comes on after a good meal; and there is a popular saying, "If you eat till you're cold, you will live to grow old," meaning, of course, that this sensation is a sign of good digestion. Well, I am not prepared to admit that; but there can be little doubt that the sensation of chilliness under these circumstances is in some degree owing to the large withdrawal of blood from the surface of the body to meet a larger demand in the digestive organs.

What purpose then does the blood serve to our working body, and why is it supplied in this peculiar manner? After the account I have given you of its wonderful distribution you must be prepared to find that it plays a most essential part in the production of energy. It is, in fact, the medium through which, by the arteries, potential energy, in the form of food and oxygen, is brought to the different tissues, there to be transformed into the actual energy of mechanical work and heat. It also carries to the tissues nutrient matter to repair their waste, and at the same time, by the veins, it carries away from these tissues those waste or refuse matters which always result from their activity.

All the energy put forth by our body is chiefly expended in two ways—as heat, and as mechanical work—and it is derived entirely from two sources—the oxygen we breathe and the food we eat. It does not lie within my province this evening to attempt to explain to you how this wonderful transformation takes place—how the latent or potential energy of food is changed into actual force. What you know so well with regard to the production of mechanical work in an ordinary machine is, let me tell you, just as true in the case of our human body, namely, that whenever there is heat and motion produced there must be supplied force from without in the form of fuel and oxygen. Let us look at what takes place in a muscle, such as the biceps of the arm, when it performs a stroke of work. What we can see is a shortening of the muscle, which looks rounder and more bulging than before, and a corresponding movement of the forearm to which it is attached. In addition to the movement we find, by placing in that muscle a very delicate thermometer, that its temperature is raised; and if we examine the blood supply we shall see two important changes—an increase of the quantity supplied and an alteration of the quality of that which comes away by the veins. The blood which comes from a contracting muscle contains, with other impurities, much more carbonic acid than when the muscle is at rest. So that you have three important changes taking place when a muscle contracts. First, an increase in the supply of blood, which carries fuel and oxygen; secondly, an increase of carbonic acid and other waste matters in the blood, which comes from the muscle; and thirdly, an elevation of temperature. Physiologists tell us that if the supply of oxygen be cut off, or the carrying away of carbonic acid be prevented, by tying the artery or the vein, no exercise of the will can cause that muscle to contract. It is, in fact, useless and paralysed.

As you are no doubt aware, the oxygen of the blood is mainly derived from the air we breathe. Now the proportion of oxygen contained in the air is practically the same everywhere, in town and country; but in many parts of our large towns there is found a poisonous admixture of carbonic acid and other impurities in the atmosphere. It is chiefly in the overcrowded and ill-ventilated dwelling-houses and workshops that these impurities are met with—where, indeed, our workpeople earn their bread and take their rest. I need not enlarge upon the necessity of pure air for the maintenance of health, but I would remind you that the constant breathing of impure air in the factory and at home is the primary cause of a very large part of the diseases of our working classes; and among the first signs of its injurious effects are languor, depression of spirits, and inability to work well either with brain or muscle. This loss of energy, produced in the first instance by impure air alone, is often the much-neglected warning of that failure in nutrition and strength which renders the human body an easy prey to the first attack of disease, and of no disease, perhaps, more frequently than consumption, in which loss of power and inability for sustained muscular effort are so sadly familiar to us.

It is not in the workshop alone, or principally, that impure air is breathed, but it is specially met with in the bedroom, where by "gentle sleep, Nature's soft nurse," the body, exhausted with hard work, should find that complete rest which is so necessary for the repair of waste and the development of fresh energy. Instead of awaking in the morning with a feeling of renewed energy, the working man often finds that he has to begin the day with a headache and feeling of lassitude, which may or may not leave him during the short but healthy respite he has in the open-air walk from a fusty-smelling bedroom to the atmosphere of a factory. It is not easy perhaps for an individual workman to call in question, much less to rectify, the ventilation of his master's factory, but every working man can surely exercise some control over the admission of fresh air into his own bedroom. He may not be, and unfortunately in the large majority of cases is not, able to secure for himself and his family, at a convenient distance from his work, a house in which the sleeping space is large enough or well ventilated enough to prevent overcrowding and to insure the proper standard of purity of the air. Small wages, with a large family, very often determine unfavourably for a man the size and arrangements of his bedroom; but there are other reasons than poverty which too often and with less excuse account for the neglect of those arrangements which secure health-giving rest and sleep. The sleeping room should be the largest in the house. The less bed-hangings, carpet, and furniture, beyond what is absolutely necessary for comfort, the better, because these things harbour impurity, and what is called *fluff*, which have a fusty smell. This fustiness is caused principally by organic impurity exhaled in the breath, and it is important to know that we have in our sense of smell a very delicate test of its presence. It seems to bear in amount a direct relation to another very serious impurity, namely, carbonic acid, which we cannot so readily detect. Remembering that the normal amount of carbonic acid in the atmosphere is about 4 in 10,000 volumes, it is surprising to find that, according to Professor Parkes, in the atmosphere of a room vitiated by respiration this fusty smell of organic matter is generally perceptible when the carbonic acid reaches only 7 in 10,000 volumes, and is very strong when the carbonic acid amounts to 1 per 1,000. Some people are very susceptible to the noxious influences of these impurities, and, in excess, their effects upon every one are headache and lassitude, depression of spirits, and inability for muscular effort. To prevent the accumulation of these impurities in the air, in the absence of special arrangements, the bedroom should always have a fire-place, and a window with the upper and lower sashes both movable. If the weather is not very severe, always keep the top sash down a few inches, or, what is perhaps better still, open the lower sash about six or ten inches, and fix under it a board exactly fitted to the size of the space opened, and the result will be a steady current of fresh air into the room upwards between the sashes. Of course there are other plans, which, though not very expensive, are not, perhaps, so simple as that I have suggested.

With regard to the supply of food in relation to work I need hardly say that what is eaten should be suitable in quantity and quality to the amount and nature of force exerted. This is, indeed, so generally recognised as to deserve the name of an axiom. Unlike the fuel of a steam engine our food is of a very complicated nature, chemically; but, like the fuel supplied to the steam engine, it contains force or energy in what is called a potential or latent state, which by the processes of digestion, and by the oxygen taken into the blood by respiration, is converted into the actual force of heat and mechanical movement. The food taken by a full-grown man serves three important purposes: it supplies fuel for mechanical work, fuel to keep up his temperature, and nutriment to repair the waste which is constantly going on, and the amount of food taken should bear a direct relation to these three conditions of work, waste, and temperature. In the case of children there is an additional claim for food for the purpose of growth.

The actual value of different articles of food as force-producers has been of late years very carefully investigated. More than ten years ago Professor Frankland published the result of his experiments, showing in the form of a table the weight and cost of various kinds of food, such as beef, butter, flour, milk, &c., that would require to be consumed in the system to raise the body of a person weighing ten stone to a height of 10,000 feet.

Such experiments, though of very great service to those who have to feed large numbers of people on strictly economical principles, as in the case of our convicts, are not of very great practical use for ordinary life. Still it is very satisfactory to find how closely the teachings of science agree with the teachings of experience. Just, however, as I told you when speaking of the amount of work a healthy man should do, so with regard to the amount of food he should take, experience and instinct are generally a very safe and sufficient guide. The sensation of fatigue gives notice of exhausted energy, and in like manner the sensation of hunger tells us when and how far this energy needs supply.

As to the quality of our food, it is unnecessary for me to trouble you with scientific details, for while under those exceptional circumstances of life I have alluded to, and especially in states of disease, it is of great importance to know scientifically the value of different kinds of food, generally speaking the taste or palate of a healthy working man chooses that which best meets his wants. It is curious to note how under extreme variations of climate and work experience and science are found so closely to agree upon this point. Thus in the arctic regions, where a large quantity of fatty food is necessary to keep up animal heat, the blubber of the whale and even a tallow candle are considered great delicacies, whereas in tropical climates, where no such necessity exists, the hydrocarbons or fats are generally held in disgust as articles of food. So among our navvies and those who are called to perform very heavy muscular work, the appetite requires a very liberal diet, and fatty food, such as bacon, which recent investigation has shown to stand in the most direct relation to the production of mechanical force, is eaten with the greatest relish.

It must not be forgotten, however, that instinct is only a safe guide in proportion to the simplicity of our habits and mode .of life. The danger is, of course, that a man may eat too much ; and by offering to the palate a great variety of richly-cooked and highly-seasoned food the sensation of hunger becomes depraved, and a great deal more is taken into the system than is required or can be put to any healthy purpose. The process of digestion itself involves a large expenditure of force, and by eating more than is enough a man must sacrifice to gluttony much of that energy which should be spent upon fruitful labour.

In addition to the quality and quantity of food in relation to work there are several other matters which it is important to remember. The food should be properly cooked, and generally taken warm, by which means digestion is rendered easier and less force expended in the process. Hard work should never be taken immediately before or after a heavy meal. In either case the stomach is rendered unequal to its task. After great exertion a little rest, and in extreme cases a short sleep or a cup of warm tea, are requisite to restore to the system sufficient energy to digest food. It is upon this principle that among the better classes there exists the very questionable habit of taking before dinner a glass of sherry and bitters, certainly unnecessary when a short rest can be substituted. A short rest after a good meal is equally necessary if the food is to be rendered available for work either with brain or muscle. I have myself seen, over and over again, among hard-working men, the most serious results of neglecting this rule, in loss of health and power for manual labour, owing in part to their own ill-timed industry, and also to the defective arrangements of their hours of labour. The interval between meals must not be disregarded. Excepting during sleep the abstinence from food should never exceed four, or at the most five, hours. In three or four hours after a wholesome meal the process of digestion in the stomach is completed, and that organ is empty. With regard to the number of meals taken in a day the traditional custom of breakfast, dinner, and supper is, generally speaking, a wise one, and well-adapted to the requirements of labour and rest. A heavy meal should never be taken at bedtime, for the simple reason that during sleep not only is all voluntary force in abeyance, but all the vital powers, including those of digestion, are much less active; so that a hearty supper, just before going to bed, cannot be easily digested, and the *rest* of sleep, instead of being refreshing, is usually made hideous with an attack of nightmare.

The food we take into our body, for the three great purposes of work, heat, and nutrition, undergoes some very obscure chemical and physical changes, by which certain substances, such as carbonic acid, urea, and uric acid, are constantly formed, together with certain salts and water. Every movement of the body, however slight, is attended with such changes, and the greater the activity of our bodies the greater will be the quantity of waste matter formed. It is important to remember that the usefulness and happiness of our lives are in a very large degree proportionate to this healthy activity and change; and if the necessity of labour sometimes presses very hard upon us, it is nevertheless robbed of half its curse by its direct physical benefit upon us. Various organs of the body are called into play to get rid of or excrete these waste products. Excreted they must be, or they will act as poisons, and healthy work will very soon cease. To get rid of the urea and uric acid the kidneys must be in good order. And let me tell you that a very frequent cause of the breaking down of the human machine is a derangement of this waste channel—a derangement which medical men call *Bright's Disease.* Among the several indirect causes of this disease overwork and alcohol, combined or separate, are probably the most efficient. I am not going to tell you that alcohol is of no use or benefit under any circumstances, for I do not believe in doctrine so extreme; but there can be no doubt that in the hard struggle for life—which is nowhere harder than it is in Manchester—instead of good and sufficient food, with rest, men substitute a stimulus to enable them to bear the undue strain under which they labour; and whenever alcohol thus takes the place of proper food, gradual but certain disease is the result. Such a practice is really a "burning the candle at both ends," for while alcohol used in this way stimulates to extra work, it does not on the one hand furnish proper fuel, and on the other hand it checks the passing off of waste matters, which are poisonous if retained in the system. Let me urge this upon you, not as my own opinion simply, but also because I believe it to be the opinion of nearly every medical man who has said anything about the subject, and whose sayings are worth attention.

For the carbonic acid there are two principal ways of exit, the lungs and the skin, both of which you know act more vigorously during muscular exercise than when we are at rest. It is especially by the lungs that the carbonic acid is got rid of, and the effect of muscular exercise upon the quality and quantity of respired air is marvellous. Dr. Edward Smith has calculated that if the quantity of the air inspired when a man is lying down be 1 volume, in walking one mile per hour it will be increased to 1·9 volume, in riding and trotting to 4 volumes, and in active exercise upon the treadmill to 5½ volumes. From these calculations a similar increase of the amount of carbonic acid exhaled can be deduced, and Dr. Parkes has shown that in an ordinary work day there are 8·69oz. of oxygen absorbed in excess of a rest day, and as much as 13oz. of carbonic acid in excess given off. A very large part of the carbonic acid is formed in the muscles alone by their contraction, and I told you that if this is not allowed to pass off freely voluntary power must very soon cease.

During active work the lungs should have free play, and everything in the dress which would interfere with easy movement of the chest should be avoided. Sudden and great exertion is always injurious, and sometimes very dangerous, the increased rush of blood to the lungs being sometimes attended with congestion, and even hæmorrhage, when the delicate blood-vessels of the air cells are unable to bear the sudden strain. I have already alluded to the effect of alcohol upon the kidneys. Its effect upon the lungs is to diminish the excretion of carbonic acid; so that when these organs are called into play during prolonged muscular effort ardent spirits should be strictly avoided.

The work of the skin is to excrete a small portion of the carbonic acid and a very large quantity of water by what we call *perspiration*. As giving exit to carbonic acid the function of the skin is not so important as the lungs, but in furthering evaporation of fluid from the blood it answers a very important purpose, namely, that of preventing an undue accumulation of heat resulting from muscular work. It is, in fact, the safety-valve, so to speak, by means of which the temperature of the blood is maintained almost constant. The temperature of the blood is in health about 100° F.; and whatever the amount of exercise, and in whatever climate, the variation in this temperature is very slight indeed. You know, I dare say practically, that evaporation of a fluid lowers temperature—how, for instance, by placing on the forehead a little ether, or some other volatile fluid, a pleasant sensation of coolness is produced as the liquid evaporates. So after great exertion you know the refreshing coolness produced by free perspiration, even in the height of summer. During active muscular exertion the fine blood-vessels of the skin become distended, rendering the surface of the body warm and red. By the action of certain minute structures called *sweat glands*, which exist to an almost innumerable extent in the skin, this extra supply of fluid is separated from the blood and brought into contact with the air and evaporated. Thus the amount of exhalation from the skin is doubled, or more than doubled, and bears a close relation to the production of heat by mechanical work. By suddenly checking this perspiration the heat of the body may very rapidly accumulate, producing languor and loss of muscular power, if not more serious consequences. There appears, however, to be very little danger of any disturbance of this temperature balance during active work, either by over-heating or over-cooling of the blood; but just after exertion, when the temperature of the body begins rapidly to fall, and while at the same time perspiration continues, there is very great danger of chilling by the too rapid cooling of the blood. It is this which makes exposure to a draught of cold air immediately after great muscular effort so very dangerous to the health.

The skin should always be kept clean by frequent bathing, so as to permit of the free unclogged action of the sweat glands. During hard muscular work the body should be lightly clothed—it matters little how lightly—but directly the work is over, and during the periods of rest, warm clothing should be put on. And let me here remind you that flannel is the best material for clothing whenever the body is exposed to rapid changes of temperature, either by reason of the climate or the necessities of labour.

So far I have spoken to you of *work* in its relation to Health. I have very imperfectly explained to you some of those sanitary rules which directly bear upon the daily work of life, and now I wish to say a few words about *Recreation.* I hope, from the general tenour of my remarks, you have not been led to suppose that hard work—bread-winning labour—is an unmitigated evil, which may by good chance and by very great caution be performed without ruin to health, but which ought to be avoided as much as possible. My intentions, however, were the very opposite, though it must be acknowledged that such an inference would not be altogether unjustified if the whole period of life is to be divided between hard work, eating, and sleeping. Very few in the present day are compelled to lead such a slavish existence as that which reduces a man's life to the condition of a mere machine. The introduction of machinery into nearly every branch of industry has done very much to deliver us from the hardship of unremitting toil. Much that was formerly degrading in hard work has been thus removed, and, in addition, the hours of labour have been very considerably shortened. Another very striking peculiarity of our civilisation is that division of labour which enables each man to gain a livelihood and supply all the wants of domestic life by the value of his skill in some one particular calling or branch of trade. Now these two things, shortening of the hours of work and division of labour, are undoubtedly very great advantages, and as such they are jealously guarded. Unfortunately, however, they are not always understood properly as they affect our physical health and strength. Clearly they imply a reserve of time and a reserve of energy for further and different employment, not for sleep, much less for idleness—which you know means mischief to ourselves or to other people.

Recreation is generally considered the proper employment for spare time, and undoubtedly we must consider it so, only let us have a proper understanding as to what we mean by that very convenient word, which is so often the cloak for everything that is vicious and unhealthy. Of course there must be work, or there can be no need of recreation. And I think you will all agree with me that whatever else is meant by recreation it is something which is intended to give rest and fresh energy for daily work, to promote health, and to give pleasure. Now change of employment is exactly that which affects these three objects of recreation. If the previous labour has been too long or too severe, of course the only form of recreation available is sleep; and, under all circumstances of life, some six or seven hours (perhaps more) of the twenty-four must be occupied by sound and undisturbed sleep. It is impossible to lay down a definite rule as to the amount necessary, owing to the varying conditions of health and work; but, generally speaking, every healthy working man requires seven hours' complete rest in this way. Overwork, and especially too much brain work, by irritating the nervous system, prevents sleep; and inability to sleep after hard work should always be regarded as very serious in its effects. To sleep easily and soundly, and to awake with a sense of refreshment, are rightly considered a sign of good health.

We are generally aware that we have worked long enough and hard enough by the sensation of fatigue. This fatigue may be general throughout the body, or it may be localised in some particular part. It is due to temporary exhaustion, and in the case of the muscles it is to be met in one of two ways, either by increasing the stimulus to contract—in other words, by making extra effort—or by allowing the muscle to rest, and thus accumulate fresh fuel for the putting forth of mechanical force.

I must here mention a curious fact with regard to the effect of work upon a muscle. By gradually and steadily increasing the amount of work done by any muscle or group of muscles they increase gradually in size, and thus adapt themselves to the increasing demand made upon them. You know, for instance, how the arm of the blacksmith, whose daily work requires a very frequent use of the hammer, increases in bulk, so that the muscles become like iron bands in firmness and strength. The limit of this increase is, however, soon reached, and if the work is too far increased it is found that the muscle instead of growing still further undergoes a process of degeneration by which its fibres waste. On the other hand, when a muscle is entirely left idle it is liable to the same process of degeneration, simply from disuse—an event which frequently happens when a limb is paralysed by disease.

Now these are very important facts to bear in mind. They show us that to increase in muscular strength the muscles must be steadily and regularly used, and that if they are overworked, or not worked at all, they gradually decrease in strength, and waste. There are very few occupations of modern life which will call into play all, or nearly all, the muscles of the body to any great extent, and fewer still, perhaps, in which the daily work is equally shared by muscle and brain. Increasing competition in trade tends to narrow for each man his sphere of labour; so that to be successful he must cultivate to the utmost and bring as nearly as possible to perfection his power for work in a very narrow field. To gain wealth, or even to earn daily bread, he must for several hours of the day concentrate in the dull repetition of a few muscular movements and mental acts nearly all his energy, neglecting for the time, and sometimes neglecting altogether, the varied and almost unlimited scope for the display of power, both muscular and mental, with which the body as a whole is endowed. Shortened hours of labour, as I said before, do afford some respite. They at least give the working man time for turning into fresh channels that residuum of power which is left to him after the day's toil—time for the exercise of those muscles which he uses very little, or not all, in his daily work—muscles which perhaps enable him to take a full breath, or to walk upright, as a man should, with his shoulders thrown well back and without stooping—and above all, time for the exercise of those mental powers the right employment of which affords the highest pleasure, and also the best condition of rest to the weary muscles.

I think you will see from what I have said that generally speaking the fatigue of life is a local fatigue, or exhaustion due to the exercise of some limited portion of the muscular system or of the mind. I hope you will also see that change of employment acts beneficially in two ways. First, it calls into use that which was previously unoccupied, and would suffer if not used; and, secondly, it affords the best stimulus to the repair and renewal of those parts which are fatigued. To repair the waste, and to renew the vigour of a wearied limb, in addition to rest there must be a sufficient supply of blood to the part, and this can be best effected, as a rule, by the gentle exercise of another part of the body. There is, however, a third condition necessary for the purpose of true recreation, namely, that the exercise, whatever it may be, should give pleasure. This must be insisted upon as a *sine quâ non* in choosing a recreative pursuit. I think it was Sir George Lewis who said that life would be tolerable if it were not for its amusements, and assuredly this was a wise saying, if the gratification of an idle fancy constitutes all the pleasure of life. I will not, however, waste your time by showing that it does not, or by any attempt to define the meaning of the word pleasure.

I shall not, however, very far err in saying that good health in itself is a source of pleasure, and that to promote good health the principle of recreation which I have laid down is, generally speaking, true and certain in its results. Time will not permit of more than allusion to the different kinds of physical and mental exercises which are useful as a means of recreation for working people. Of those which are intended to train the muscles, and to give strength to the body generally, there are two kinds—first, the more or less artificial plan of the gymnasium, which comprises exercises on the horizontal bar, the parallel bars, the trapeze, &c. Secondly, those somewhat old-fashioned English games and exercises such as cricket, football, rowing, &c., which generally are carried on in the open air. A rather broad distinction must be made between these two classes of exercises. Both are useful, and should have the same object—namely, to strengthen that which is weak, and to give healthy vigour to the whole body. So long as these objects are kept in view by a careful choice of the right kind of exercise suitable for each individual a good result will be obtained. It is very easy, however, to make a grave mistake as to the suitability of any particular exercise. In gymnastics a man is tempted to use those muscles which best do their work and to neglect those which are weak and most require training, and he may very easily overstrain and injure himself by the too sudden and violent exertion of those muscles which are weak. The same thing may and does happen in outdoor games, but the danger of these mistakes being made is far less. The exertion and strain put forth in outdoor games is, generally speaking, much more evenly distributed over the body. If gymnastics be adopted as a means of recreation and training they should always, if possible, be practised under the systematic guidance of a skilled teacher, who can find out the weak points and suggest the right exercise, whereas in outdoor games a much greater licence may be allowed. Besides the general benefit to the muscular system obtained by proper physical exercise, the health is greatly improved in every way by the increased action of the heart and lungs which accompanies it. In this way the system is relieved of those impurities to which I have before alluded, and the renewal of those tissues which are worn or fatigued is greatly assisted. In whatever way muscular exercise is taken it should be systematic and graduated, never violent and sudden. Neglect of this precaution is often far more serious in its results than no exercise at all, especially as regards the heart and lungs.

With regard to mental exercise as a pure recreation it is impossible to speak too highly. As a relief from worry, with all its attendant evils, and as a means of refreshment to the whole body, it stands unrivalled by any physical recreation that has ever been devised. For a small, though increasing, number of people it is the only or chief work of life; and it is interesting to find that the statistics of mortality show that for mental workers the tether of human life is lengthened beyond that of almost any other class. Dr. Beard, of New York, found the life-value of 500 men of the greatest mental activity—poets, philosophers, men of science, politicians, musicians—to be 64 years. On comparing this average with that of an equal number belonging to the rest of society, he found the latter to be but 50 years. Among the causes for this difference in the length of life in favour of the brain-workers, Dr. Richardson and others consider the recreative character of intellectual labour to be the most influential. Of course there may be an over-cultivation of the mind, which, instead of being recreative to the health of the body, is positively injurious, just as there is often an over-cultivation of muscular power. The most common mistake made with regard to recreation in modern life is that which Mr. Maclaren, of Oxford, has so well pointed out—namely, that of making great strength in some one exercise, or in some part of the body, instead of good general health, the object of recreative pursuits. The true object and purpose of recreation is not to make a man a great pedestrian, or a great athlete, or even a great thinker and philospher; but it is rather, by the exercise and culture of all the powers, physical and mental, with which we are endowed, to enable us most fitly and with pleasure to do the work of life without pain, without disease, and as long as possible.